5.17 PALEONTOLOGICAL RESOURCES

SECTION 5.17 PALEONTOLOGICAL RESOURCES
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5.17 PALEONTOLOGICAL RESOURCES

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. This section assesses the potential that earth-moving associated with construction of the proposed Tesla Power Project (TPP) would impact scientifically important fossil remains. The following sections describe the existing environmental setting, the environmental effects of construction and subsequent operation, cumulative impacts, proposed mitigation measures during construction and operation, agency contacts, permit requirements and schedules, and references cited.

The analysis presented in this section meets all requirements of the California Energy Commission (CEC, 2000) and incorporates the Society of Vertebrate Paleontology (SVP 1995, 1996) standard measures for mitigating potential adverse construction-related environmental impacts on paleontological resources. Fossil locations from the archival search are presented in confidential Appendix O.

5.17.1 Affected Environment

5.17.1.1 Geographic Location and Physiographic Environment

The project site is located in the northeastern corner of Alameda County, and a portion of San Joaquin County, along the western edge of the San Joaquin Valley, adjacent to the eastern-most foothills of the Coast Ranges. The project area falls within the Coast Range physiographic province, and is bounded on the west by ridges that comprise the Diablo Range, and on the east by the flood plain of the San Joaquin River within the Central Valley physiographic province.

The project area is located within the U.S. Geological Survey (USGS) Midway Quadrangle (1:24,000).

5.17.1.2 Geologic Setting and Formations

The geology of the project area is described in Section 5.5, Geologic Resources and Hazards. The TPP site and its ancillary facilities are located on map units Tps (the Neroly Formation, part of the San Pablo group), Tn (Pliocene-age non-marine sedimentary rocks, Tulare Formation), and Qa (Quaternary alluvium) (Dibblee 1980). These stratigraphic units are described below.

San Pablo Group (Neroly Formation)

The term San Pablo Group has a long history of varied use in the geological literature (e.g., Weaver 1909; Clark 1915; Patten 1947; Hall 1958; Wagner 1978). Overall, the San Pablo Group and its included formations represent marine Miocene sedimentation while coeval terrestrial deposits are assigned to the Contra Costa Group (e.g., Graham et al. 1984). The deposits record fluctuations in the locations of upland or mountainous sediment sources and their related stream deposits as well as the shoreline and marine sedimentary environments into which these streams drain. The various formations reflect sediment derived from both the

Sierra Nevada and uplands in the vicinity of the present Coast Range and record changes in the shoreline over time.

In the project area, the Neroly Formation is the only exposure of San Pablo Group rocks (Huey 1948; Dibblee 1980). The Neroly Formation is composed of conglomerates, sandstones, shales, and volcanic ash deposits (Huey 1948). Notably, the conglomerates and sandstones are derived from the volcanic andesites of the Mehrten Formation of the Sierra Nevada (Huey 1948; Wagner 1978). Wagner (1978) reports that to the east and north of the Mt. Diablo uplift, continental vertebrates and land plants are common while to the southwest they are replaced by marine fossils. Huey (1948), however, reports terrestrial fossils from the Neroly Formation within the Tesla quadrangle to the south of the project area.

Tulare Formation

The term Tulare Formation is used on the west side of the San Joaquin Valley for all deformed nonmarine sediments overlying Pliocene marine rocks (Woodring et al. 1940; Davis and Coplen 1989). These deposits represent various alluvial fan, stream, flood basin, and lake environments. Non-marine deposits of morphologically recognizable alluvial fans or stream terraces are not considered part of the formation.

The Tulare Formation is thickest in the southern part of the San Joaquin Valley (e.g., near the Kettleman Hills) and thins to the north (Davis and Coplen 1989). It ranges in age from Pliocene to early Quaternary in age (Woodring et al. 1940). It is recognized extensively in both the subsurface and in exposures along the western valley and easternmost Coast Range. Examination of the composition of the Tulare Formation in the subsurface has been used to evaluate the depositional history of the San Joaquin Valley including the variation over time of the influxes of sediment from the Sierra Nevada and the Coast Ranges (e.g., Davis and Coplen 1989). The Corcoran Clay Member of the Tulare Formation is a deposit of lake clays that underlies much of the San Joaquin Valley. The Friant ash that lies immediately above the Corcoran Clay has a potassium-argon date of 615,000±31,000 years (Marchand and Allwardt 1981). The base of the Corcoran Clay is estimated by correlating volcanic ash to dated ashes and by determining magnetic polarity intervals. Deposition of the Corcoran Clay began at least 725,000 years ago (Davis and Coplen 1989).

Quaternary Alluvium

Sediment deposition by streams into the San Joaquin Valley or basin has continued from Tulare time to the present day. Currently, the streams draining the Coast Range transport sediments onto the alluvial fan surfaces and sometimes beyond into the flood basin of the San Joaquin River. Above these present streams and their recent deposits are older alluvial fan or stream terrace landforms and deposits (Lettis 1985; Sowers et al. 1992). Additionally, these stream sediments can sometimes be traced up into the Coast Range valleys; the TPP site includes Quaternary alluvium that fill the lower parts of the valley although recognizable stream terraces were not observed. These landforms and deposits record the depositional history of these streams but also reflect the tectonic uplift history of the Coast and Diablo

Range which has caused the streams to erode down into both the bedrock of older formations, the San Pablo Group, Neroly Formation, Tulare Formation, and older alluvial fan deposits (Lettis 1985; Sowers et al. 1992).

The alluvial deposits of the San Joaquin Valley have been extensively studied. San Joaquin Valley and Sacramento Valley surficial geologic investigation of these landforms and deposits include Marchand and Allwardt (1981), Cherven (1984), Harden (1987), Busacca et al. (1989), and Wagner et al. (1990). Extensive paleontological materials are identified by Hansen and Begg (1970) in east Sacramento. Lettis (1985) and Sowers et al. (1992) describe Quaternary alluvial fans and associated Quaternary alluvium on the west side of the San Joaquin Valley.

Because of the overall lithologic similarity between the Quaternary sedimentary formations in the Central Valley, there are five principal characteristics that are used to differentiate and identify stratigraphic units: (1) discontinuities between formations; (2) distinctive lithology and stratigraphic superposition; (3) relative elevation or position of geomorphic surfaces; (4) surface form and the degree of erosional dissection of original depositional surfaces; and (5) contrasting degrees of soil development (Marchand and Allwardt 1981; Busacca et al. 1989). This overall approach has been used throughout the Central Valley including the east and west sides of the San Joaquin Valley (e.g., Marchand and Allwardt 1981; Lettis 1985; Harden 1987; Sowers et al. 1992). While present, the paleontological record of land mammals in these Quaternary formations is generally not used for detailed correlation.

Fossil Content

The San Pablo Group (Neroly Formation), Tulare Formation, and Quaternary alluvium in the vicinity of the project site have yielded fossils in the past. Since excavations at the project site will encounter these rock formations, it is possible that paleontological resources may be affected.

5.17.1.3 Paleontological Resource Inventory Methods

A stratigraphic inventory and paleontological resource inventory were completed to develop a baseline paleontological resource inventory of the project site and surrounding area by rock unit, and to assess the potential paleontological productivity of each rock unit. Inventory methods included a review of published and unpublished literature and a field survey. These tasks complied with CEC (1997, 2000) and SVP (1995) guidelines.

Stratigraphic Inventory

Geological maps and reports covering the geology of the project site and area were reviewed to determine the exposed rock units and to delineate their respective areal distributions in the project area.

Paleontological Resource Inventory

Published and unpublished geological and paleontological literature were reviewed to document the number and locations of previously recorded fossil sites from rock units

exposed in and near the project site and surrounding area and the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the University of California Museum of Paleontology in Berkeley, California on April 19, 2001. Fossil locations from the archival search are presented in confidential Appendix O.

Field Survey

The field reconnaissance was conducted on May 19, 2001, to document the presence of any previously unrecorded fossil sites and of strata that might contain fossil remains. The survey was conducted by Tom Stewart, Ph.D., a qualified paleontologist with several publications in refereed scientific journals addressing fossils and paleonvironments. Reconnaissance was limited to inspection of visible ground surface at the site as well as the natural gas pipeline, water supply pipeline, and transmission line routes. No exposures of potentially fossiliferous strata were observed in the TPP construction zone. Examination of adjacent exposures and landforms verified the geologic mapping in the area. A complete pedestrian survey of the entire project area of potential effect for paleontological resources was considered unnecessary due to the vegetation cover over the area.

5.17.1.4 Paleontological Resource Assessment Criteria

The potential paleontological importance of the project area can be assessed by identifying the paleontological importance of exposed rock units within the project area. Since the areal distribution of a rock unit can be easily delineated on a topographic map, this method is conducive to delineating parts of the project that are of higher and lower sensitivity for paleontological resources and to delineating parts of the project that may therefore require monitoring during construction.

A paleontologically important rock unit is one that: (1) has a high potential paleontological productivity rating, and (2) is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site. However, well-documented fossil-bearing formations are less likely to yield a unique paleontological resource.

An individual vertebrate fossil specimen may be considered unique or significant if it meets the following criteria: it is 1) identifiable, 2) complete, 3) well preserved, 4) age diagnostic, 5) useful in paleoenvironmental reconstruction, 6) a type or topotypic specimen, 7) a member of a rare species, 8) a species that is part of a diverse assemblage, and/or 9) a skeletal element different from, or a specimen more complete than, those now available for its species. For example, identifiable and complete vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. The value or importance of different fossil groups varies, depending on the age and depositional environment of the rock

unit that contains the fossils, their rarity, how complete the skeleton is, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions such as part of a research project. Individual portions of a vertebrate skeleton, e.g., an individual vertebrate, would generally not be considered a unique paleontological resource. Marine invertebrates are generally common and well documented. They would generally not be considered a unique paleontological resource.

The following tasks were completed to establish the paleontological importance of each rock unit exposed at or near the project site:

- The potential paleontological productivity of each rock unit exposed at the project site was assessed, based on the density of fossil remains previously documented within the rock unit.
- The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

5.17.1.5 Resource Inventory Results

Regional surficial geologic mapping of the project site and vicinity (1:125,000 or 1:500,000 scale) is provided by Bartow (1991) and Wagner et al. (1991). Larger scale mapping of the project site (1:24,000 or 1:62,500 scale) is provided by Dibblee (1980) and Huey (1948). As discussed in Section 5.17.1.2, the relative ages of the mapped formations are fairly well established.

Broader scale information on late Cenozoic land mammal and other fossils of the San Francisco Bay area and vicinity are found in Stirton (1939), Savage (1951), and Jefferson (1991a, 1991b).

Paleontological Resource Inventory and Assessment by Rock Unit

San Pablo Group (Neroly Formation)

Merriam (1898; in Clark (1915) and Hall (1958) originally designated the San Pablo formation along the shore of southern San Pablo Bay based on the presence of marine *Astrodapsis* and *Echinarachnious*. Clark (1915) provides a compilation of approximately 165 marine invertebrate species in the San Pablo. Patten (1947) lists leaf impressions, casts of small pectens and a type of boring pelecypod from the San Pablo. Huey (1948) did not identify marine fossils within the Neroly Formation in the project vicinity (Tesla quadrangle). He did, however, collect fossil leaves, horse teeth [*Nannippus cf. tehonensis* (Merriam)], and petrified wood to the south of the project area. Hall (1958) discusses the history of the formation nomenclature as well as summarizing the paleontological materials including those listed by Huey (1948). Appendix O lists four fossil localities in the San Pablo Group and one in the Neroly Formation within three miles of the project site. The Neroly Formation record is an elk bone while the San Pablo Formation records include horse teeth, camel, rabbit and Xenartha (armadillos, anteaters, and sloths).

Tulare Formation

Reiche (1950) reports probable Pleistocene fossils of horse, ground sloth, camel, and tapir from Tulare Formation exposures in the Delta-Mendota Canal to the northeast of the project site. Huey (1948) found no fossils within the Tulare Formation exposures in the Tesla quadrangle. He reports, however, that fossil camel and ground sloth were collected from the Tulare Formation in the Carbona quadrangle to the south of the project area. The Corcoran Clay member of the Tulare Formation has numerous fossils remains, including diatoms, pollen, and many species of freshwater clams (Woodring et al. 1940; Dodd and Stanton, 1975; Davis and Coplen 1989). Appendix O lists three fossil localities in the Tulare Formation within three miles of the project site. These contain remains of ray-finned fish teeth and vertebrate, sturgeon, perch, and a black goose sternum.

Quaternary Alluvium

In the eastern San Joaquin Valley some land mammal fossils have been located in these formations and they have provided useful material for absolute dating. Harden (1987) compiled absolute age data on fossils collected from these formations during stratigraphic investigations. Vertebrate fossils of Irvingtonian age were collected by Marchand and Allwardt (1981). In east Sacramento similar fossils collected from exposures in two gravel quarries have yielded uranium dates of about 103,000 years old (Hansen and Begg 1970). Hanson and Begg (1970) report a wide variety of Rancholebrean fossils collected in situ from stratigraphic sections that were well exposed in the gravel quarries and that could therefore be related to specific stratigraphic positions. Appendix O lists nine fossil localities in the Quaternary alluvium within three miles of the project site. These records include portions of bison, horse, ground sloth, mammoth tooth, camel tooth, and Xenartha (armadillos, anteaters, and sloths).

5.17.2 Environmental Consequences

The potential environmental effects from construction and operation of the TPP on paleontological resources are presented in the following subsections.

5.17.2.1 Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. In areas of high sensitivity that are likely to yield unique paleontological resources, full-time monitoring is typically recommended during any project ground disturbance. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past, typically are considered to have low sensitivity and monitoring is usually not needed during project construction. Areas that have not had any previous paleontological resource surveys or fossil finds are considered undetermined until surveys and mapping are done to determine their sensitivity. After reconnaissance surveys, observation of exposed cuts, and possibly sub-surface testing, a qualified paleontologist can determine whether the area should be categorized as having high,

low, or undermined sensitivity. In keeping with the criteria of the SVP (1995), all vertebrate fossils are categorized as being of potentially significant scientific value. However, as discussed in Section 5.17.1.4, a wide variety of criteria must also be considered in determining significance under CEQA.

Appendix G of CEQA addresses significance criteria with respect to paleontological resources (Public Resources Code Sections 21000 et seq.). Appendix G(V)(c) asks if the project will "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

Using the CEQA criteria, guided by SVP (1995), the significance of the potential adverse impacts of earth moving on the paleontological resources of each stratigraphic unit exposed in the project site construction zone was assessed. This assessment reflects the paleontological importance and impact sensitivity of the stratigraphic unit.

5.17.2.2 Construction

This section presents the potential adverse impacts on the paleontological resources resulting from construction of each portion of the TPP.

Power Plant Site

Potential impacts on paleontological resources resulting from construction of the proposed Tesla Power Project generation plant can be divided into construction-related impacts and impacts related to plant operation. Construction-related impacts to paleontological resources primarily involve ground disturbance.

The proposed Tesla Power Project site is situated on Neroly Formation, and Quaternary alluvium with some potential to extend onto Tulare Formation. Since fossil remains have been reported from these geologic rock types in the vicinity of the project area, there is a possibility that excavation and grading may encounter significant vertebrate fossils during project construction. However, only complete vertebrate fossils would generally be considered unique and/or potentially significant because of their general rarity. Fragments of the vertebrate fossils listed previously would generally not be considered significant because such fossils are not complete and they have already been recovered from the formations. Non-vertebrate fossils would not be considered significant because they have been collected from these formations and documented. Because of the large number of fossil remains reported within a three-mile radius of the project site, it is recommended that a paleontological monitor be present on-site during excavation activities.

Natural Gas Pipeline

Excavation for and installation of approximately 2.8 miles of gas pipeline will involve ground-disturbing activities in sediments of the Neroly Formation, Tulare Formation and Quaternary alluvium. In other areas in the general vicinity of the project site, these rock units have yielded vertebrate fossils. Thus, similar to the power plant site, these excavations could encounter significant paleontological resources. Because of the large number of fossil remains

reported within a three-mile radius of the project site, it is recommended that a paleontological monitor be present on-site during excavation activities.

Water Supply Pipeline

Excavation for and installation of approximately 1.7 miles of gas pipeline will involve ground-disturbing activities in sediments of the Neroly Formation, Tulare Formation and Quaternary alluvium. In other areas in the general vicinity of the project site, these rock units have yielded vertebrate fossils. Thus, similar to the power plant site, these excavations could encounter significant paleontological resources. Because of the large number of fossil remains reported within a three-mile radius of the project site, it is recommended that a paleontological monitor be present on-site during excavation activities.

Electric Transmission Line

Construction of the transmission tower bases for the proposed 0.8 mile of electrical transmission lines will involve ground-disturbing activities in sediments of the Quaternary alluvium and underlying Neroly Formation which has yielded vertebrate fossils in the overall vicinity. Thus, similar to the power plant site, these excavations could encounter significant paleontological resources. Because of the large number of fossil remains reported within a three-mile radius of the project site, it is recommended that a paleontological monitor be present on-site during excavation activities.

5.17.2.3 Operation

Project operation will not cause additional ground disturbance, and therefore will not affect paleontological resources.

5.17.3 Cumulative Impacts

If paleontological resources were encountered during the TPP-related ground disturbance, the potential cumulative effect on paleontological resources would be low, as long as the mitigation measures proposed below in Section 5.17.4 are implemented to recover the resources. When properly implemented, these mitigation measures would effectively recover the scientific value of significant fossils encountered during TPP construction. Thus, the proposed TPP will not cause or contribute to significant cumulative impacts to paleontological resources.

5.17.4 Mitigation Measures

This section describes measures that The Applicant proposes to reduce or mitigate potential project-related adverse impacts to significant paleontological resources.

- **Paleontological Mitigation Plan**—The paleontological resource mitigation program will include the preparation of a mitigation and monitoring plan for construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; pre-construction coordination; and reporting.

- **Paleontological Monitoring**—Prior to construction, The Applicant will retain a qualified paleontologist to design and implement a mitigation program during project-related earth-moving activities for deep excavation at the power plant site, for deep boring for electrical transmission towers, and for construction of the natural gas pipeline. The paleontologist will conduct a limited field survey of exposures of sensitive stratigraphic units in areas that will be disturbed by earth moving. The paleontologist will monitor earth-moving construction activities where this activity will disturb previously undisturbed sediment. Monitoring will not take place in areas where the ground has been previously disturbed, in areas underlain by artificial fill, or in areas where exposed sediment will be buried but not otherwise disturbed.
- **Construction Personnel Education**—Prior to the start of construction, construction personnel involved with earth-moving activities will be informed of the possibility of encountering fossils, how to identify fossils, and proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist.

Implementation of these mitigation measures will reduce the potentially significant adverse environmental impact of project earth-moving activities on paleontological resources to an insignificant level. These measures will allow for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data that otherwise might have been destroyed by construction and unauthorized fossil collecting.

5.17.5 Laws, Ordinances, Regulations, and Standards (LORS)

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes, most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies and by the state of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established for vertebrate fossils by the SVP (1995, 1996). Design, construction, and operation of the TPP, including transmission lines, pipelines, and ancillary facilities, will be conducted in accordance with all LORS applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 5.17-1 and discussed briefly below, along with SVP professional standards.

Table 5.17-1. Applicable LORS Regarding Paleontological Resources

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Protects objects of antiquity from vandalism and unauthorized collecting on federal lands (Delta-Mendota Canal, Federal Bureau of Reclamation)	Section 5.17.5	yes
CEQA, Appendix G	Fossil remains may be encountered by earth-moving activities	Section 5.17.4, Section 5.17.5	yes
Public Resources Code, Sections 5097.5/5097.9	State lands (Caltrans right-of-way on I-580; California Aqueduct, California Department of Water Resources)	Section 5.17.5	yes

Federal LORS

Federal protection for significant paleontological resources would apply to the TPP if any construction or other related project impacts were to take place on federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of antiquity on federal land. For project facilities, federal lands are encountered by the natural gas pipeline crossing beneath the Delta-Mendota Canal, under the jurisdiction of the Federal Bureau of Reclamation.

State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (Public Resources Code Sections 15000 et seq.) with respect to paleontological resources. CEQA's Appendix G (Public Resources Code Sections 21000 et seq.) lists among its significant effects when a project will "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

Other state requirements for paleontological resource management are in Public Resources Code Chapter 1.7, Section 5097.5, *Archaeological, Paleontological, and Historical Sites*. This statute specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. For project facilities, state lands are encountered by the water supply pipeline and natural gas pipeline crossings of Caltrans right-of-way (I-580), and at the California Aqueduct (California Department of Water Resources).

County LORS

Alameda and San Joaquin counties do not have mitigation requirements that specifically address potential adverse impacts to paleontological resources.

Professional Standards

The Society of Vertebrate Paleontology (SVP 1995, 1996), a national scientific organization of professional vertebrate paleontologists, has established standard guidelines that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, specimen preparation, analysis, and curation. Most practicing professional paleontologists in the nation adhere to the SVP's assessment, mitigation, and monitoring requirements, as specifically spelled out in its standard guidelines.

5.17.6 Involved Agencies and Agency Contacts

There are no state agencies having specific jurisdiction over paleontological resource issues.

5.17.7 Permits Required and Permit Schedule

No state agency would require a paleontologic collecting permit to allow for the recovery of fossil remains uncovered by construction-related earth moving on state and private land in the project site.

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